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Construction Engineering
Research Laboratory

US Army Corps of Engineers®

Sustainability in Army Family Housing

LEED® for Homes— Pilot Study

Evaluation for Use in Army Family Housing

Lisa Bobotas and Matt Hinson
Center of Standardization for Army Family Housing, Norfolk District
Also: Paul Christensen, Gary Headley, Rich Schneider,
and Annette Stumpf

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Lisa Bobotas and Matt Hinson

Center of Standardization for Army Family Housing, Norfolk District
U.S. Army Corps of Engineers
803 Front Street
Norfolk, VA 23510-1011

Paul Christensen

U.S. Army Assistant Chief of Staff, Installation Management
2511 Jefferson Davis Highway
Presidential Towers, Rm 8829
Arlington, VA 22202-3926

Gary Headley

Sacramento District
1325 J Street
Sacramento, CA 95814-2922

Rich Schneider and Annette Stumpf

Construction Engineering Research Laboratory
U.S. Army Engineer Research and Development Center
PO Box 9005
Champaign, IL 61826-9005

Final report

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Abstract: Army participation in the *LEED® for Homes* Pilot Program is intended to facilitate preparations and transition from SPiRiT to *LEED® for Homes* as soon as it is ready for adoption. The pilot program will coincide with U.S. Green Building Council (USGBC) development of the *LEED® for Homes* evaluation tool. The Office of the Assistant Chief of Staff (Installation Management) Housing Division has overall responsibility for the transition and has selected Norfolk District, Center of Standardization for Family Housing to facilitate and coordinate participation in the *LEED® for Homes* Pilot Program.

A team consisting of Army personnel experienced in Army Family Housing (AFH) and/or sustainability conducted site visits to AFH at Fort Lee, VA and Fort Huachuca, AZ. Both installations have a history of successful AFH projects and current projects under construction that used SPiRiT as a sustainability rating tool. *LEED® for Homes* was applied to each AFH project. Further, each credit was evaluated for applicability to Army projects and its ease of application using current design guidelines. Where appropriate, feedback was provided to the USGBC regarding issues, concerns, or clarifications on particular credits. The team also defined several Innovation and Design credits that could universally apply to AFH projects.

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Unit Conversion Factors

Multiply	By	To Obtain
feet	0.3048	meters

Preface

This study was conducted for the Office of the Assistant Chief of Staff for Installation Management (OACSIM) under the Project, "LEED® for Homes – Pilot Study."

The work was managed and executed by a project team under the Center of Standardization, Army Family Housing, Norfolk District, U.S. Army Corps of Engineers. The project team analyzed the LEED® for Homes tool for implementation by the Army. Members of the team included Norfolk District Engineering and Construction staff, Sacramento District Project Manager, Los Angeles District Construction staff, the Engineering Research and Development Center, Construction Engineering Research Laboratory sustainability staff, and the proponent from the Army Chief of Staff for Installation Management.

At the Construction Engineering Research Laboratory (CERL), Donald Hicks is Chief, Engineering Processes Branch, and Michael Golish is Chief, Facilities Division. The Technical Director for the Installations business area is Martin J. Savoie. The Deputy Director of CERL is Dr. Kirankumar V. Topudurti, and the Director is Dr. Ilker R. Adiguzel.

CERL is an element of the U.S. Army Engineer Research and Development Center (ERDC), U.S. Army Corps of Engineers. The Commander and Executive Director of ERDC is COL Richard B. Jenkins, and the Director of ERDC is Dr. James R. Houston.

1 Introduction

Background

To meet sustainability goals, the U.S. Army is transitioning from the Sustainable Project Rating Tool (SPiRiT) to the U.S. Green Building Council (USGBC) Leadership in Energy and Environment Design (LEED®) evaluation tool. LEED®-NC (New Construction) has been adopted for projects beginning with Fiscal Year 2008. *LEED® for Homes* is currently under development by the USGBC and is expected to be launched in November 2007. The U.S. Army has elected to participate during the pilot phase to ascertain the applicability of *LEED® for Homes* as an effective evaluation tool for Army Family Housing (AFH) projects.

Objectives

The team has been assembled at the direction of the Assistant Chief of Staff for Installation Management (ACSIM) to accomplish the following objectives:

- evaluate current sample AFH projects and processes using the proposed *LEED® for Homes* tool;
- recommend an agreement with USGBC for U.S. Army Corps of Engineers (USACE) review services in conjunction with AFH projects;
- provide feedback to USGBC during the pilot period for refinement of the rating tool; and
- provide feedback to ACSIM for development of implementation instructions.

Approach

This pilot study included training on the use of the *LEED® for Homes* tool for the team, two site visits to review current AFH projects as agreed upon by ACSIM and USACE, evaluation of a representative sampling of homes in these projects using the *LEED® for Homes* checklist (current at the time of the site visit), and compilation of findings in a report to ACSIM.

Scope

This analysis of *LEED® for Homes* is focused on application of this rating tool to AFH construction projects within the Continental United States

(CONUS). Its application to projects outside the United States (OCONUS) and to projects under the Residential Communities Initiative (RCI) is not fully addressed by this study. For OCONUS projects, much more detailed analysis, outside the scope of this study, would be necessary to determine how to apply *LEED® for Homes* where the building standards, materials, and methods differ significantly from U.S. norms. This is consistent with ongoing discussions regarding the application of the LEED®-NC tool. Once that application is better understood, an approach for application of *LEED® for Homes* must be developed. For projects under RCI, many of the items regarding lessons learned and specific credits identified in this study would still be applicable. The specific requirements for transition from SPiRiT to *LEED® for Homes* for RCI would be determined by that program's managers. The Project Management Plan provides specific scope of services in more detail.

2 *LEED® for Homes* Rating Tool/Pilot Study

The *LEED® for Homes* rating tool is in a year-long pilot study during which industry is testing the tool on actual projects and providing feedback to USGBC for the development of the final *LEED® for Homes* rating tool. This U.S. Army is participating in this process.

Checklist

The *LEED® for Homes* checklist (version 1.73) used for this study is included at the end of this chapter (Figures 1 and 2) for reference. Since the time of this analysis, the checklist has undergone substantial changes in the number of credits and scoring requirements, though its structure is essentially the same. No attempt has been made by the team to re-evaluate the pilot projects against the revised criteria, as it is continuing to evolve. The credits are organized into eight sections. Some credits have mandatory measures that must be met in order for a home to be certified; some do not and earn points for each measure that meets defined criteria. The specific requirements for each credit are described in a rating system manual. Both the latest rating checklist and applicable guidance are available from the USGBC at the *LEED® for Homes* Website.

It is important to fully understand how each credit is measured. The study team has provided some specific discussion in Chapters 4 and 5 for several of these credits related to AFH. In particular, Credit Interpretation Requests (CIRs), which allow points for project features not specifically scored elsewhere, can be applied programmatically to all AFH projects.

Project team member roles and responsibility

Project team member roles and responsibilities are slightly different for *LEED® for Homes* compared with other LEED® rating tools. During formal LEED® Certification for LEED®-NC or EB (Existing Building) projects, a delegate from the main USGBC office is assigned the responsibility for determining which LEED® credits are earned and what the final LEED® rating is for the project.

Since so many homes are being built in the United States, the *LEED® for Homes* Pilot Study has introduced a new role called a *LEED® for Homes* "Provider," who shares advice and expertise with home builders in his/her

region. The USGBC selected 12 Regional *LEED® for Homes* Providers to provide technical, marketing, and verification support to builders during the first phase of this pilot study. The 12 Providers were selected because of their proven record of supporting builders in the construction of sustainable, high performance homes. During the pilot study, the role of the *LEED® for Homes* Providers is to select appropriate pilot projects and verify that the chosen homes are built to meet the requirements of the rating system. Each Provider typically selects one or more builders and evaluates a few of their homes. Eventually the USGBC hopes to have well-qualified Providers in all the geographic and regional markets where builders and customers want to build *LEED® for Homes* certified projects.

The Army *LEED® for Homes* Pilot Study project team served in the role of Provider during this pilot project, but was not officially designated as one of the 12 official USGBC *LEED® for Homes* Providers. Since the AFH projects the team evaluated were ongoing and already under contract, the team could not redirect the builder to change any aspect of the ongoing projects. Instead, the two projects were reviewed from a Provider perspective to evaluate how well using the *LEED® for Homes* rating tool and process would work within current business practices and legal constraints. The project team also rated homes at each of the AFH pilot sites to see what rating the homes would earn "as-is," and how improvements could be made to the home rating.

The project team worked with USGBC to establish a "sampling protocol" that would allow the team to evaluate a sample of the typical home models being built at each project site. This sampling helped the team reduce the number of homes to be rated at each site and better corresponded with the existing quality assurance/quality control (QA/QC) process being used onsite. A "sampling protocol" will be formalized by USGBC when the tool is fielded and is consistent with the QA/QC process.

The project team is considering alternatives before recommending which process might be best for future AFH projects using *LEED® for Homes*. One alternative is for the Center of Standardization (CoS) for AFH or other USACE employees to serve in the role of *LEED® for Homes* Provider for AFH projects. Another alternative is for the AFH project Contractors to work directly with a USGBC *LEED® for Homes* Provider throughout the project. Advantages and disadvantages of these options are discussed in Chapter 5.

Project team training

Pilot Study project team members completed one or more of the following: *LEED® for Homes* Provider training, *LEED® for Homes* web-based training, LEED® Accredited Professional training, and regular participation in *LEED® for Homes* committee activities.

LEED for HOMES

Project Checklist

(Version 1.73 - October 19,2005)

Builder Name: *Maximum Points* [2]

Address (Street/City/State): *Dry* Normal *Wet*

Detailed information on the measures in the checklist below are provided in the companion document "LEED for Homes Rating System"

Yes	?	No								
Location and Linkages (LL)								OR	10	
HOLD					LEED-ND Neighborhood			LL2-5	10	
				2	**Site Selection**	Avoid Environmentally Sensitive Sites and Farmland		LL1	2	
				3.1	**Infrastructure**	Site within 1/2 Mile of Existing Water, Sewer, and Roads		LL1	1	
				3.2		Select an Infill Site		LL1	1	
				4.1	**Community Resources**	Within 1/4 mile of Basic Community Resources / Public Transportation		LL1	1	
				4.2	*OR*	Within 1/4 Mile of Extensive Community Resources / Public Transportation		LL1	2	
				4.3	*AND/OR*	Within 1/2 Mile of Green Spaces		LL1	1	
				5.1	**Compact Development**	Average Housing Density >/= 7 Units / Acr		LL1	1	
				5.2	*OR*	Average Housing Density >/= 10 Units / Acre		LL1	2	
				5.3	*OR*	Average Housing Density >/= 20 Units / Acr		LL1	3	
			Sub-Total							
Yes	?	No	**Sustainable Sites (SS)**						14	
Y				1.1	**Site Stewardship**	Minimize Disturbed Area of Site (If Site > 1/3 Acre)			Mandatory	
Y				1.2		Erosion Controls (During Construction)			Mandatory	
Y				2.1	**Landscaping**	Basic Landscaping Design			Mandatory	
				2.2		Apply 3 to 4 Inches of Mulch Around Plants			1	
				2.3		Limit Turf	5		3	1
				2.4		Minimize Landscape Water Demand	3		2	1
				3	**Shading of Hardscapes**	Locate and Plant Trees to Shade Hardscapes			1	
Y				4.1	**Surface Water Management**	Install Permeable Material for at Least 65% of Lot (If Lot >/= 1/4 acre)			Mandatory	
				4.2		Use Permeable Paving Materials	1		3	5
				4.3		Design and Install Permanent Erosion Controls	1		2	3
				5	**Non-Toxic Pest Control**	Select Insect and Pest Control Alternatives from Lis			2	
			Sub-Total							
Yes	?	No	**Water Efficiency (WE)**						12	
				1.1	**Water Reuse**	Rainwater Harvesting System			1	
				1.2		Grey Water Re-Use System			1	
Y				2.1	**Irrigation System**	Main Shutoff Valve, Sub-Meter, and Third-Party Inspection			Mandatory	
				2.2		Select High Efficiency Measures from List	5		3	1
				2.3		Rain Sensing Controls			1	
				3.1	**Indoor Water Use**	High Efficiency Fixtures (Toilets, Showers, and Faucets)			3	
				3.2	OR	Very High Efficiency Fixtures (Toilets, Showers, and Faucets)			6	
			Sub-Total							
Yes	?	No	**Indoor Environmental Quality (IEQ)**					OR	14	
				1	**ENERGY STAR with IAP**	Meets ENERGY STAR w/ Indoor Air Package (IAP)		IE2-10	10	
Y				2.1	**Combustion Venting**	Space Heating and DHW Equip w/ Closed/Power-Exhaust; & CO Monitor		IE1	Mandatory	
Y				2.2		Fireplaces w/ Outside Air Supply and Closed Combustion		IE1	Mandatory	
				3	**Humidity Control**	Analyze Moisture Loads AND Install Central System (where Needed)		IE1	1	
Y				4.1	**Outdoor Air Ventilation**	Meets ASHRAE Std 62.2		IE1	Mandatory	
				4.2		Dedicated Outdoor Air System (w/ Heat Recovery)		IE1	2	
				4.3		Third-Party Testing of Outdoor Air Flow Rate into Home			1	
Y				5.1	**Local Exhaust**	Meets ASHRAE Std 62.2		IE1	Mandatory	
				5.2		Timer / Automatic Controls for Bathroom Exhaust Fans		IE1	1	
				5.3		Third-Party Testing of Exhaust Air Flow Rate Out of Home			1	
Y				6.1	**Supply Air Distribution**	Meets ACCA Manual D		IE1	Mandatory	
				6.2		Third-Party Testing of Supply Air Flow into Each Room in Home			2	
Y				7.1	**Supply Air Filtering**	>/= 8 MERV Filters, w/ Adequate System Air Flow		IE1	Mandatory	
				7.2		>/= 10 MERV Filters, w/ Adequate System Air Flow			1	
				7.3	*OR*	>/= 12 MERV Filters, w/ Adequate System Air Flow			2	
Y				8.1	**Contaminant Control**	Seal-Off Ducts During Construction		IE1	Mandatory	
				8.2		Permanent Walk-Off Mats *OR* Central Vacuum			1	
				8.3		Third-Party Testing of Particulates and VOCs before Occupancy			1	
Y				9.1	**Radon Protection**	Install Radon Mitigation System if Home is Located in EPA Region 1		IE1	Mandatory	
				9.2		Install Ground Contaminant Mitigation System (Outside of EPA Region 1)		IE1	1	
Y				10.1	**Vehicle Emissions Protection**	No Air Handling Equipment OR Return Ducts in Garage		IE1	Mandatory	
Y				10.2		Tightly Seal Shared Surfaces between Garage and Home		IE1	Mandatory	
				10.3		Exhaust Fan in Garage OR No Garage in Contact with Hon		IE1	1	
			Sub-Total							Page 1

Figure 1. *LEED® for Homes* Project Checklist (front).

Yes	?	No						
			Materials and Resources (MR)					**24**
			1	**Home Size**	Home that is Smaller than National Average			10
			2.1	**Material Efficient Framing**	No Extra Uses of Lumber for Aesthetic Purposes			Mandatory
			2.2		Advanced Framing Techniques			2
			3	**Local Sources**	Materials Extracted / Manufactured / Produced within 500 Miles			3
Y			4.1	**Durability Plan**	Detailed Durability Plan; (Pre-Construction)			Mandatory
			4.2		Third-Party Verification of Implementation of Durability Plan		1	3 5
Y			5.1	**Environmentally Preferable**	Tropical Hardwoods, if used, must be FSC			Mandatory
			5.2	**Products**	Select Environmentally Preferable Products from List			4
Y			6.1	**Waste Management**	Max of 2.5 Lbs Per Square Foot of Construction Waste Sent to Landfill			Mandatory
			6.2		0.5 Pts for Each Additional 0.5 Lbs Per Square Foot Reduction			2
			Sub-Total					
Yes	?	No	**Energy and Atmosphere (EA)**			OR		**29**
Y			1.1	**ENERGY STAR Home**	Meets ENERGY STAR for Homes with Third-Party Testing			Mandatory
			1.2		Exceeds ENERGY STAR for Homes, 2 Pts Per HERS Point > HERS 86	**EA2-7**		16
Y			2.1	**Insulation**	Third-Party Inspection of Insulation Installation, At Least HERS Grade II	**EA1**		Mandatory
			2.2		Third-Party Inspection of Insulation Installation, At Least HERS Grade I	**EA1**		1
			2.3		*OR* Above Code Insulation; At Least 5% > Local Code Per REScheck	**EA1**		1
Y			3.1	**Air Infiltration**	Third-Party Envelope Air Leakage Tested </= 0.35 ACH	**EA1**		Mandatory
			3.2		Third-Party Envelope Air Leakage Tested </= 0.25 ACH	**EA1**		1
			3.3		*OR* Third-Party Envelope Air Leakage Tested </= 0.15 ACH	**EA1**		2
Y			4.1	**Windows**	Windows Meet ENERGY STAR for Windows (See Table)	**EA1**		Mandatory
			4.2		Windows Exceed ENERGY STAR for Windows by >/= 10% (See Table)	**EA1**		1
			4.3		*OR* Windows Exceed ENERGY STAR for Windows by >/= 20% (See Table)	**EA1**		2
Y			5.1	**Duct Tightness**	Third-Party Duct Leakage Tested </= 5.0 CFM25 / 100 SF to Outside	**EA1**		Mandatory
			5		Third-Party Duct Leakage Tested </= 3.0 CFM25 / 100 SF to Outside	**EA1**		1
			5.3		*OR* Third-Party Duct Leakage Tested </= 1.0 CFM25 / 100 SF to Outside	**EA1**		2
Y			6.1	**Space Heating and Cooling**	Meets ENERGY STAR for HVAC w/ Manual J & refrigerant charge test	**EA1**		Mandatory
			6.2		Exceeds ENERGY STAR for HVAC by >/= 10%, w/ Manual J	**EA1**		1
			6.3		*OR* Exceeds ENERGY STAR for HVAC by >/= 20%, w/ Manual J	**EA1**		3
			7.1	**Water Heating**	Improved Hot Water Distribution System			3
			7.2		Improved Water Heating Equipment	**EA1**		3
			8.1	**Lighting**	Energy Efficient Fixtures and Controls			1
			8.2		*OR* ENERGY STAR Advanced Lighting Package			3
			9.1	**Appliances**	Select Appliances from List			2
			9.2		Very Efficient Clothes Washer (MEF > 1.8,*AND* WF< 5.5)			1
			10	**Renewable Energy**	Renewable Electric Generation System (1 Point / 10% Annual Load Reduction)			6
			11	**Refrigerant Management**	Minimize Ozone Depletion and Global Warming Contribution			1
			Sub-Total					
Yes	?	No	**Homeowner Awareness (HA)**					**1**
Y			1.1	**Homeowner Education**	Basic Owner's Manual and Walkthrough of LEED Home			Mandatory
			1.2		Comprehensive Owner's Manual and Multiple Walkthroughs / Trainings			1
			Sub-Total					
Yes	?	No	**Innovation and Design Process (ID)**					**4**
			1.1	**Innovative Design**	Provide Description and Justification for Specific Measure			1
			1.2		Provide Description and Justification for Specific Measure			1
			1.3		Provide Description and Justification for Specific Measure			1
			1.4		Provide Description and Justification for Specific Measure			1
			Sub-Total					
			Project Totals [1] (pre-certification estimates)					**108**

Notes: 1. **Certified** 30-49 points **Silver** 50-69 points **Gold** 70-89 points **Platinum** 90-108 points
2. "Points" are shown for 3 precipitation zones: Dry (< 20 inches / year); Normal (20-40 inches / year); and Wet (> 40 inches / year)

I hereby attest that I have verified all of the indicated credits above as installed in the home identified above.

Rater's Name _____ Company _____

Signature _____ Date _____

I hereby attest that I have reviewed the verification information, and certify that this home meets the requirements of LEED for Homes

Provider's Name _____ Company _____

Signature _____ Date _____

Page 2

Figure 2. *LEED® for Homes* Project Checklist (back).

3 Project Site Visits

Fort Lee, VA

The project selected for evaluation at Fort Lee was Madison Park, Phase 1. This project was the first phase of a program to construct homes for junior enlisted Soldiers (Figure 3). At the time of the site visit, the project (consisting of 90 units at a Programmed Amount of $18 million) was approximately 80 percent complete. The project was required to meet SPiRiT Silver criteria. The team reviewed documentation including the Request for Proposal (RFP), the construction contract documents, the Contractor's design documents, and construction submittals. They inspected both completed units and units in various stages of completion. The site visit gave the Army *LEED® for Homes* Pilot Study project team a comprehensive view of all aspects of the project to which to apply the *LEED® for Homes* tool.

Figure 3. Madison Park family housing, Fort Lee, VA.

The first of the two site visits, the analysis of the Fort Lee project, enabled the team to determine many of the features of the standards that already enable achievement of many *LEED® for Homes* credits, such as Energy Star compliance. Further, it highlighted some features unique to a large military family housing project that are not well suited to this kind of analysis, such as the specific lot size determination. These items are discussed in more detail later in this report.

Only a few unique sustainable features were in this project beyond what was required to meet the SPiRiT rating and are normally found in current AFH projects. Therefore, this project was a good representation of a typical AFH project. After looking at the homes in detail and calculating all the

credits, it was determined that units in this project could be *LEED® for Homes* Certified. It was also determined that *LEED® for Homes* Silver could be achieved with fairly minor adjustments in specifications or products if required by the RFP.

Fort Huachuca, AZ

The project selected for evaluation at Fort Huachuca was the family housing project near Sierra Vista, AZ, which involved the demolition of former housing built around 1957 and the construction of 204 new units (Figure 4).

Figure 4. AFH at Fort Huachuca, AZ.

At the time of the site visit, the project consisted of 204 units at a Programmed Amount of $42 million. The team reviewed documentation including the RFP, the construction contract documents, the Contractor's design documents, and construction submittals. They inspected both completed units and units in various stages of completion. The site visit gave a comprehensive view of all aspects of the project from which to apply the *LEED® for Homes* tool.

Upon completion of the evaluation, it was determined that units in this project could be *LEED® for Homes* Silver. The project received a SPiRiT Silver certification with a potential total score (with Post assistance of 40 to 70 points) of SPiRiT Gold. Unlike the Fort Lee project, the team noted several innovative design features such as drip irrigation, rock mulch, and reduction of the turf lawn size that were incorporated due to the desert location of the homes. Solar tube-like skylights (Figure 5) were installed to capture and diffuse light in interior spaces, especially those lacking windows, mainly in large storage spaces that are often converted to playrooms or offices by residents. Other highlighted sustainable technologies include salvaged materials from demolished units, and the use of recycled asphalt

and concrete from site infrastructure. Storm water is to be detained in rock detention basins in common areas and Greenbelt connections.

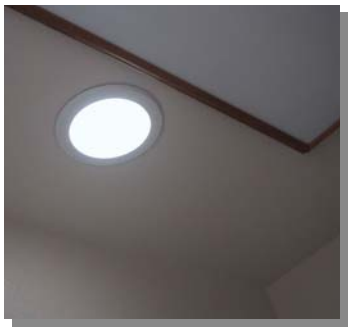

Figure 5. Solar tube skylights.

The design/build team found that high desert winds require the use of heavy tile roofing instead of shingles, which may blow off. Other lessons learned include such findings as: "Buy American" requirements limit access to innovative products manufactured abroad; asbestos and lead-based paint mitigation prohibit the salvage of many materials; solar tube skylights are an excellent solution for illumination of nonperimeter areas, and computerized, weather-sensitive irrigation designed for golf courses may be used to conserve water in residential projects.

Issues

Numerous credits warrant detailed discussion. These credits are itemized and discussed in more detail in Chapter 4.

4 Detailed Discussion of Specific Credits

This chapter includes analysis of specific credits in the *LEED® for Homes* rating tool as they apply to AFH. The chapter is divided into three sections. First (Table 1), several issues surfaced during the evaluation where current AFH standards or processes are difficult to evaluate or present problems in meeting the minimum mandatory measures. Second (Table 2), it was evident that, in several areas, existing Army standards and RFP documents already require items that meet or exceed credit measures. Figure 6 shows the energy star label found on windows of the homes evaluated by the team at Fort Huachuca. Third (Table 3), in several areas minor changes in standards or processes could result in AFH projects earning additional *LEED® for Homes* credits. The discussion in this chapter relates directly to the *LEED® for Homes* checklist in Chapter 2.

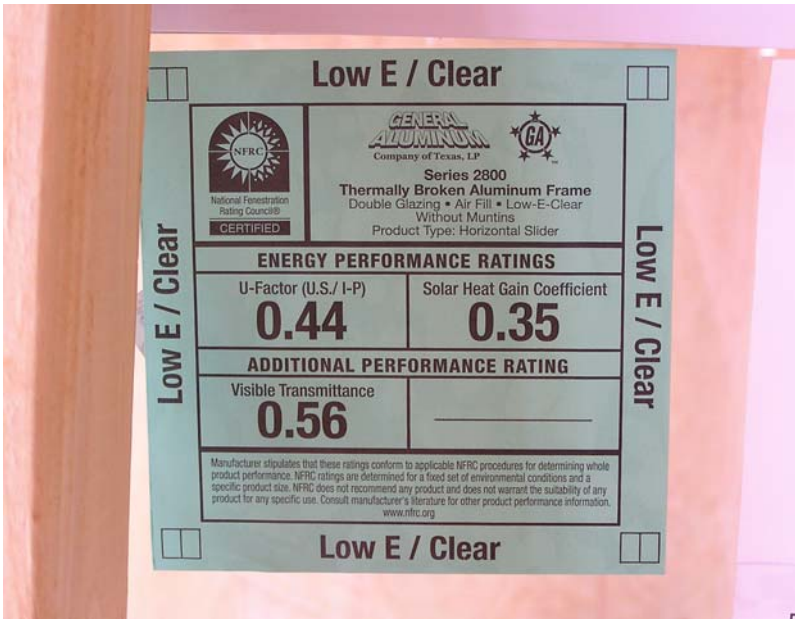

Figure 6. Energy performance rating label.

Where modification to AFH guidance is required, the CoS for AFH, Norfolk District, will be responsible for recommending and implementing these changes within approved AFH standards. The Unified Facilities Criteria (UFC) 4-711-01 Family Housing was published 13 July 2006. The Army will issue a supplement to this UFC that will replace Army Technical Instruction 801-02 and includes the model RFP for AFH. This is the appropriate criteria document to communicate technical instructions related to *LEED® for Homes*.

Analysis of credits

Table 1. Credits with issues or concerns or where we do not meet mandatory measures.

Credit	Issue	Recommendation
LL4.1	In general, public transportation is not available on Army installations, or service is limited.	Sustainability needs to be considered in Installation Master Planning and during the planning and programming of projects. Follow-on could include sustainability emphasis in Directorate of Public Works (DPW) training courses.
LL4.2	AFH often not within ¼ or ½ mile from Community Resources.	Sustainability needs to be considered in Installation Master Planning and during the planning and programming of projects. Follow-on could include sustainability emphasis in DPW training courses.
LL5.1	Lot size is not clearly defined for AFH projects. For calculating density, lot must be defined.	Use minimum setback dimensions as defined in the RFP to determine the lot size. Clearly identify this definition in RFP document and cross-reference to *LEED® for Homes* credits.
SS4.3	Via Credit Interpretation Request (CIR). Strategies required for AFH projects may not meet exact requirements for this credit; however, requirements for run-off reduction meet the intent of this credit and should be eligible for a CIR.	Pursue CIR approval and state allowable credit in RFP pointing to the applicable *LEED® for Homes* credit.
WE1.1	Via CIR. Generally, permanent irrigation systems are not installed, but we can direct downspouts to turf areas, and utilize drought-tolerant plants.	No mandatory measures. Strengthen language in RFP to require factors to earn CIR. Pursue CIR approval and state allowable credit in RFP pointing to the applicable *LEED® for Homes* credit.
WE2.2	Via CIR. See WE1.1.	Take credit where certified landscape design indicates no irrigation required. Points earned depend on climate region.
WE2.3	Via CIR. See WE1.1.	Take credit where certified landscape design indicates no irrigation required – 1 point earned.
MR1	Home size is dictated by AFH criteria. Program benchmarks and construction maximums for higher ranks and more bedrooms earn negative points for this credit.	Mandatory to score each type of unit. Add size point credit chart to RFP and cross-reference to *LEED® for Homes* credit. See Appendix A for proposed chart and credits.
MR2.2	Current AFH criteria do not place emphasis on material-efficient framing techniques.	Add language to RFP to encourage material-efficient framing and point to *LEED® for Homes* credit.
MR3	Current AFH criteria do not place emphasis on local sources for building materials.	No mandatory measures. Add language to RFP to document use of local sources and point to *LEED® for Homes* credit. Points earned depend on number of locally procured components up to 3 points.
MR4.1	AFH projects do not meet mandatory measures. AFH criteria do not require compilation of data to complete durability plan.	Team questioned the value of this credit. USGBC has been updating guidance for this credit to make it less cumbersome. Providing feedback to USGBC.

Credit	Issue	Recommendation
MR5.1	AFH criteria do not regulate use of tropical hardwoods, but due to cost, these materials are normally not used.	Add language to RFP for compliance with mandatory measures. Reference *LEED® for Homes* credit.
MR5.2	AFH criteria do not encourage use of Listed Environmentally Preferable Products (EPP).	Add language to RFP to encourage/require use of EPP and to provide verification documentation. Reference *LEED® for Homes* credit.
MR6.1	AFH criteria do not require documentation in level of detail required to determine compliance with waste management requirements. However, new Army policy requires projects to include contract performance requirements to divert at least 50% of nonhazardous construction and demolition (C&D) debris from landfill disposal.	Add language to RFP regarding compliance with Memorandum dated July 11, 2006, Subject: Sustainable Management of Waste in Military Construction, Renovation, and Demolition Activities – Supplemental Guidance. (Memo) (Guidance)

Table 2. Credits earned by current AFH criteria/procedures.

Credit	Issue	Recommendation
SS1.2	Erosion and sediment control measures are already required by AFH criteria.	Meets Requirement – no additional points earned.
IEQ2.1	Combustion Venting of Equipment and carbon monoxide monitoring already required by AFH criteria.	Meets Requirement – no additional points earned.
IEQ2.2	Fireplaces not normally provided in AFH projects.	Meets Requirement – no additional points earned.
IEQ4.1	Outdoor Air Ventilation required to meet American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) 62.2.	Meets Requirement – no additional points earned.
IEQ4.3	Third party testing of outdoor air flow rates already required by AFH criteria and current testing procedures.	Meets Requirement – 1 point earned.
IEQ5.1	Local exhaust must meet ASHRAE 62.2.	Meets Requirement – no additional points earned.
IEQ5.3	Third-party testing of exhaust air flow rate already required by AFH criteria and current testing procedures.	Meets Requirement – 1 point earned.
IEQ6.1	Supply air distribution must meet Air Conditioning Contractors of America (ACCA) Manual D requirements.	Meets Requirement – no additional points earned.

Credit	Issue	Recommendation
IEQ6.2	Third-party testing of supply air flow already required by AFH criteria and current testing procedures.	Meets Requirement – 2 points earned.
IEQ8.1	Army criteria/RFP requires ducts to be sealed off during construction or cleaned.	Meets Requirement – no additional points earned.
IEQ9.1	Army criteria/RFP requires radon protection if in Environmental Protection Agency (EPA) Zone 1.	Meets Requirement if outside zone - 1 point earned.
IEQ9.2	UFC 3-490-04a is required to be followed.	Meets Requirement – 1 point earned.
IEQ10.1	AFH criteria do not permit air handling units and return ducts in garages.	Meets Requirement – no additional points earned.
IEQ10.2	AFH criteria for separation between garage and living area meet requirements for sealing.	Meets Requirement – no additional points earned.
EA3.1	Third-party testing of building envelope leakage is required by AFH criteria and current testing procedures.	Meets Requirement – no additional points earned.
EA4.1	AFH criteria for window Energy Star rating meet minimum requirements.	Meets Requirement – points earned depend upon rating of windows provided.
EA5.1/2/3	Third-party testing of duct tightness is required by AFH criteria and current testing procedures.	Meets Mandatory Requirement – additional points earned depending upon test results.
EA6.1/2/3	AFH criteria for heating, ventilating and air-conditioning (HVAC) equipment Energy Star rating meet minimum requirements.	Meets Mandatory Requirement – additional points earned depending upon equipment provided.
EA9.1	Contractor is required to provide Energy Star rated equipment.	Meets Requirement – points earned depend upon rating of windows provided. However, specification should be improved to include other appliances.

Table 3. Credits easily achieved by minor criteria changes or other factors.

Credit	Issue	Recommendation
LL4.3	Green space is encouraged and frequently provided by current AFH criteria.	Strengthen language in RFP and point to specific *LEED® for Homes* credit.
SS1.1	Most AFH lots, if defined as discussed in Section 4 , 5.1, will be < 1/3 acre.	None.
SS2.1	AFH or installation criteria normally meet mandatory measures for landscaping.	Strengthen language in RFP to ensure all projects comply and point to specific *LEED® for Homes* credit.
SS2.2	AFH or installation criteria normally meet mandatory measures for mulch.	Strengthen language in RFP to ensure all projects comply and point to specific *LEED® for Homes* credit.
SS4.1	Most AFH lots, if defined as discussed in Section 4, 5.1, will be < 1/4 acre.	None.
IEQ8.3	Third-party testing for particulates and volatile organic compounds (VOCs) not currently required, but could be.	Add language in RFP to conduct this testing.
IEQ10.3	AFH criteria required attached garages, but exhaust fans are not required.	Add language in RFP to provide exhaust fans in garages.
EA1.1	Third-party inspection of Energy Star compliance not clear. Contractors currently must only provide statement of compliance.	Clarify intent of third-party verification – allow Corps QA personnel to complete. Add language to RFP to ensure all projects comply with Energy Star requirements.
EA7.1	AFH criteria do not require Energy Star rating for water heaters.	No mandatory measures. Add language in RFP to provide Energy Star labeled water heater.
EA8.1	AFH criteria do not require Energy Star rating for light fixtures.	No mandatory measures. Strengthen language in RFP to encourage use of Energy Star labeled light fixtures, photovoltaic exterior fixtures, and/or compact fluorescent lamps.
ID1.1	Holistic design/Charrette process	Identify in RFP credits earned by this Army design process.
ID1.2	Acoustic environment/Noise control	Identify in RFP credits earned by the requirement to meet noise abatement standards.
ID1.3	Other Innovation and Design credits	Claim additional credits for unique project features.
ID1.4	Other Innovation and Design credits	Claim additional credits for unique project features.

5 Evaluation Method/USACE Services to USGBC on AFH Projects

LEED® Certification currently requires involvement by a third-party "Provider" to conduct testing and evaluation. Several methods exist by which AFH may be certified. Those methods are presented here with a recommendation that option 4 would be preferred.

Analysis

Possible options for *LEED® for Homes* certification/validation are:

1. Contractor could hire USGBC Provider to conduct independent certification. The entire process would be within the Contractor's control with QA by USACE. The cost of this effort depends on many factors such as project size, number of different *unit* types, and location (with respect to the Provider). This cost would be in addition to the cost of construction, though some would be a trade-off from Contractor testing to Provider testing.

   Advantages: Contractor would be responsible for all aspects of the certification — all reviews, testing, inspections, and coordination — upon award; would result in *LEED® for Homes* certification.

   Disadvantages: Higher cost due solely to the evaluation process; Provider as a subcontractor.

   Note: It is possible that no *LEED® for Homes* Provider is located within a convenient distance to remote Army installations where housing projects are being built. This might complicate the *LEED® for Homes* certification process and increase *LEED® for Homes* Provider travel costs.

2. USACE could hire USGBC Provider to conduct independent certification. This method would result in *LEED® for Homes* certification. The cost of this effort depends on many factors such as project size, number of different unit types, and location (with respect to the Provider). This cost would be in addition to the cost of construction, though some would be a trade-off from Contractor testing to Provider testing.

Advantages: USACE would ensure independent evaluation; would result in *LEED® for Homes* certification.

Disadvantages: Higher cost due solely to the evaluation process (fee paid to Provider); USACE would assume responsibility for coordination of the reviews, testing, inspection and coordination, which would be an additional Design During Construction (DDC) cost to the project; this process is not consistent with the policies followed for Military Construction (MILCON) projects implementing LEED®-NC.

3. USACE could become a USGBC Provider and perform all certification activities for all AFH projects.

   Advantages: USACE would ensure independent evaluation; would result in *LEED® for Homes* certification

   Disadvantages: USACE would assume responsibility for coordination of the reviews, testing, inspection and coordination, which would be an additional DDC cost to the project. This alternative might be of questionable value given the number of upcoming CONUS AFH construction projects; however, if utilized for privatized projects (e.g., RCI) as well, a qualified team could more realistically be sustained.

4. Contractor could meet *LEED® for Homes* certification requirements and follow procedures similar to those already established by the Army for LEED®-NC. Formal *LEED® for Homes* certification would not be required; however, the contractor/project delivery team will fulfill the role of the *LEED® for Homes* provider and see that the project is documented and rated according to USGBC requirements. The supporting Engineer District, as Authorized Design and Construction Agent, would be responsible for reviewing the project documentation and validating all credits, in accordance with the USGBC standard, from design through construction close-out.

   Advantages: Additional costs to the project would be kept to a minimum and not be significantly more than with current SPiRiT process; this process is already established for LEED®-NC on other MILCON projects.

Disadvantages: Contractor would have complete control of the process and would rely on USACE QA to validate; would not result in *LEED® for Homes* certification.

Recommendations

The Pilot Study project team recommends adoption of option 4 where *LEED® for Homes* follows basically the same process in place for LEED®-NC projects. The Army does not fully support spending additional funds solely for the purpose of LEED® certification. The exact method of accomplishment would be to use the tools as fielded by USGBC.

6 Feedback for U.S. Green Building Council

As part of this study, the team has identified specific items of concern regarding the definition, relevance, or application of some of the credits. This chapter describes specific feedback given to the USGBC. In August 2006, team member Rich Schneider participated in the *LEED® for Homes* retreat, representing the Army's interests on a team consisting of owners, designers, contractors, and USGBC staff. Together the team provided feedback from pilot projects to analyze and validate the pilot scoring system. The result of this effort was a significant rework of *LEED® for Homes* scoring.

Feedback to USGBC

LL 4.1 – Community Resources

- Army "Facility Types" Versus *LEED® for Homes* "Community Resources" — Army facility types standardized by regulation do not directly match *LEED® for Homes* Community Resources; additionally, there are many types that potentially apply. Since Army facility types are defined as standard, suggest they be pre-approved as applicable. Army projects will propose equivalents. Samples are provided in Table 4.

Table 4. Comparison of community and Army facility types.

LEED-H Community Resource	Army Facility Type
Bank	Bank or Credit Union
Community Center	Community or Morale, Welfare and Recreation (MWR) Type Functions – Housing Office, Army Community Services Center, Skill Development Center, Youth Center, Automotive Skills Center, Indoor Swimming Pool, Auditorium, Bowling Center, Drug And Alcohol Abuse Counseling Center, Army Continuing Education, Child Development Center, Community Activities Center, Recreation Center, Community Fitness Center, Indoor Roller or Ice Skating Rink, and Private/Organizational Club.
Convenience Store	Exchange Branch (Army/Air Force Exchange Service [AAFES] Shopette)
Fire Station	Fire Station
Laundry or Dry Cleaner	Laundry/dry cleaning pick-up point (AAFES), and Steam Cleaning Facility, MWR
Library	Library Main or Branch
Medical or Dental Office	Medical Centers/Hospitals; Dental Clinics

LEED-H Community Resource	Army Facility Type
Park	Recreation or MWR Type Functions – Physical Fitness and Outdoor Community Fitness Centers; Recreation/Picnic Area; Playgrounds; Baseball, Softball, and Multipurpose Athletic Fields; Jogging/Fitness/Bike Trails; Running Track; Basketball, Volleyball, Badminton, and Tennis Court Areas; Golf, Miniature Golf, and Pitch and Putt Courses, and Driving Ranges; Outdoor Ice and Roller Skating Rinks; Skateboard Park; Archery and Skeet Ranges; Outdoor Swimming Pools and Aquatic Recreational Centers; Riding Stables and Arenas; Marina Facilities; Vehicle Race Track; Outdoor Theater; and Recreational Trailer Park/Campground
Pharmacy	Pharmacy
Police Station	Police Station
Post Office	Army Post Office (APO)
Place of Worship	Multi-Denominational Chapel; Religious Education; and Family Life Center Facilities
Restaurant	Post (Installation) Restaurant, Consolidated Open Dining Facility (Community Club), Enlisted Open Dining Facility (Enlisted Club), Officer Open Dining Facility (Officers Club), Exchange Cafeteria, Fast Food/Snack Bar (Cyber Cafe, Food Court, Burger King, Popeyes, etc.), Post (Installation) Dining Facilities
School	Dependent School
Supermarket	Commissary
Other Neighborhood-Serving Retail	Military Clothing Sales Store; Sports Pro Shop; Exchange Main or Branch Retail Store (AAFES); Exchange Automotive Service Station, Maintenance Shop, and Car Wash; Exchange Service Outlets (Barber, Florist Shop, etc.); Exchange Concessions; and Community Thrift Shop.
Other Office or Major Employment Center	Administrative and Classroom Facilities (in general)

- Army Chapel and Religious Education Facilities – The Army does not provide separate "place of worship" facilities for each denomination; chapels are multi-denominational and services are staggered. The Army proposes that the number of Places of Worship credited as community resources equal the number of denominations served (normally Protestant, Catholic, and Jewish) at each facility. In the private sector, these facilities would be separate and individually counted.

LL 5.1 – Compact Development

- Army Site Definition – Lot sizes are not clearly defined for AFH projects. For calculating density, lot sizes will be calculated on the following basis:
  - Rear – minimum 40 feet or other defining boundary (such as a permanent fence); (from criteria, rear to rear distance is 80 feet);

- Side – minimum 10 feet or in accordance with required setback for applicable density (from criteria, side to side distance is 20 feet);
- Front – minimum sidewalk to structure; if no sidewalk, then 10 feet from curb (right of way) to structure; and
- Common space is excluded by definition from the calculations.

SS 4.3 – Surface Water Management

- Strategies employed, while not meeting the letter or the requirement for run-off reduction, meet the intent of the credit and should be eligible under CIR.

WE 2.1, 2.2, and 2.3 – Irrigation System

- Mandatory Main Shutoff Valve, Sub-Meter, and Third-Party Inspection – The Army proposes that the Prerequisite is met if no irrigation system is installed.
  - The *LEED® for Homes* committee previously discussed making WE 2.1 optional, but as of August 2007, it is still a requirement.
- High Efficiency Measures and Rain Sensing Controls – The Army proposes that both credits are met if there is: 100 percent elimination of potable water for irrigation; no permanent irrigation system installed; implementation of drought tolerant/native turf and plant species; and guidance in homeowner manual on irrigation and turf species. Credit documented through certified landscape design indicating no irrigation required.

IEQ 4.2 – Outdoor Air Ventilation

- Dedicated Outdoor Air System – Clarification is needed on the definition of "dedicated." The strictest interpretation is that 100 percent outdoor air is required and that no operable windows are allowed. The presumed interpretation is that "an outdoor air supply system must be provided that complies with ASHRAE Standard 62.2 AND provides for heat transfer between the incoming outdoor air stream and exhaust air streams (except in very mild and dry climates) AND has fully ducted supply and exhaust" (LEED-H Rating tool, credit 1EQ4.2).

IEQ 9.1 & 9.2 – Radon Protection

- Incorrect Terminology – EPA defines radon threats by Zone not Region.

IEQ 10.3 – Vehicle Emissions Protection

- "Passive" vent carbon monoxide (CO) control – The Army proposes that the credit is met without mechanical ventilation if garage space is directly vented to the exterior (local codes [Fort Huachuca] require direct venting of garage space to exterior; homes provided with passive permanent vent for CO control].

MR 4.1 – Durability Plan

- Excessive Non-Value Added Prerequisite – The Army considers this credit to be excessive given the scale of the target project (e.g., one single-family residence). (Note: This credit was improved in the next LEED-H pilot version 1.1a.)

MR 5.2 – Products Select Environmentally Preferable Products from List 4

- VOC Materials Separated from Interior Spaces – The Army proposes that, if VOC-containing components are separated from interior spaces (e.g., wall insulation) via complete vapor barrier, they are acceptable.

7 Ideas for Sustainability and Energy Savings in AFH

This chapter discusses technologies, resources, and ideas that could be used in AFH projects to improve sustainability and reduce energy and water consumption. The private sector has many wonderful examples that can be learned from.

USGBC *LEED® for Homes* resources

The *LEED® for Homes* website contains resources such as "Frequently Asked Questions" and a list of "16 Ways to Green Your Current Home" to help home owners and builders lower the impacts of everyday living.
http://www.usgbc.org/DisplayPage.aspx?CMSPageID=147#learn

Net zero energy homes

The concept of a "net zero energy" home is now feasible. Net-zero energy buildings create as much energy as they consume throughout the year, resulting in net zero energy consumption from the utility provider. These homes are connected to the utility grid, so they can use commercially provided power when necessary, and feed excess power back to the grid when it is not needed (called "net metering"). Numerous resources on the Internet explain various efforts to design and build zero-energy or net-zero energy homes. The U.S. Department of Energy (DOE) has an ongoing effort and web resources that can help project teams identify proven ideas. Here is one useful link from the DOE website that describes regional best practices: http://www.eere.energy.gov/buildings/building_america/

DOE's Zero Energy Homes research initiative published a fact sheet "Moving Toward Zero Energy Homes," which lists recent success stories including an entire subdivision of 257 homes that approach zero energy consumption at Vista Montana in Watsonville, CA. The fact sheet is available at this URL:
http://www.eere.energy.gov/buildings/info/documents/pdfs/35317.pdf

The basic elements of a zero energy home are:

- Climate-specific design
- Passive solar heating and cooling

- Energy-efficient construction, appliances, and lighting
- Solar thermal and solar electric systems.

Energy Star houses

Army family houses incorporate Energy Star principles in their projects. Energy Star information for new homes is available at this web resource: http://www.energystar.gov/index.cfm?c=new_homes.hm_index. Of particular interest is the "National Builder Option Package," which describes how to meet Energy Star requirements for each state. The file can be found on this web page: http://www.energystar.gov/index.cfm?c=bldrs_lenders_raters.homes_guidelns09

Solar RCI development

Actus Lend Lease, an RCI provider, is building for the Army one of the largest solar subdivisions in the world in Hawaii. This community will use 7 megawatts of solar power to provide 15 to 45 percent of resident needs, and will recycle nearly 80 or 90 percent of the materials from demolished homes. See these websites for more information on this community success story: http://www.actuslendlease.com/llweb/all/main.nsf/all/oc_oc_cp_haw and http://www.phma.com/PHMA_DOWNLOADS/2006.NovDec.DC.pdf

Advanced housing technology

PATH – A Public-Private Partnership for Advancing Housing Technology has a list of their selections for the Top 10 Technologies and numerous other resources on their website: http://www.pathnet.org/ The technologies were selected after considering their strengths in the following areas: quality and durability; energy efficiency; environmental performance; safety and disaster mitigation; and affordability. (For detailed information on each technology, see http://www.pathnet.org/sp.asp?id=10587)

1. Mold Resistant Gypsum
2. Solar Water Heating
3. Recycled Concrete Substitutes and Aggregates
4. Combined Heat and Power (CHP)
5. Horizontal Axis Washer/Dryer
6. Hydrophilic, Impact-Resistant Windows
7. Super-Sized (Vertical) Insulating Concrete Forms (ICFs)

8. Induction Cooktops
9. Global Positioning Systems (GPS) for Land Development
10. Permeable Pavers and Pavement.

The PATH ToolBase provides homebuilders the information they need to apply new technologies and practices to their work—from installation instructions to building code restrictions, and from cost-benefit studies to construction alternatives. http://www.pathnet.org/sp.asp?id=1394

ToolBase recommendations - seven steps to a zero energy home

This ToolBase web page describes the basic steps a designer/builder need to take to achieve a successful zero energy home http://www.toolbase.org/Home-Building-Topics/zero-energy-homes/seven-steps-zeh. The article thoroughly discusses how to achieve these seven important steps:

1. Decrease the energy requirements for space heating, cooling, and water heating
2. Increase the efficiency of the furnace (or heat pump) and the air-conditioner
3. Install a solar hot water pre-heat system, and efficient backup water heater, and an efficient distribution system
4. Install efficient lighting fixtures
5. Install efficient appliances
6. Install a properly sized photovoltaic (PV) system
7. Turn off lights, computers, and appliances when not in use.

Residential Architect online top products

Each year the online publication *Residential Architect* selects a favorite top 100 new building products. http://www.residentialarchitect.com/ Links to the products are available online at: http://www.residentialarchitect.com/industry-news.asp?sectionID=0&articleID=313474

The top 100 products last year included tankless water heaters and solar-energy systems (such as PV-powered roof ventilation fans that would be an excellent way to cool attics in AFH). http://www.ebuild.com/articles/article.hwx/Q/articleId.313476 .

Building Green top 10 green building products

Building Green, Inc., publisher of the *GreenSpec® Directory* and *Environmental Building News*™, selected their 2006 Top-10 Green Building Products, which can be found at this URL: http://www.buildinggreen.com/press/topten2006/index.cfm The Top-10 products include:

- Polished concrete system from RetroPlate
- Underwater standing timber salvage by Triton Logging
- PaperStone Certified composite surface material from KlipTech Composites, Inc.
- Varia and "100 Percent" recycled-content panel products from 3form, Inc.
- Recycled-content interior molding from Timbron International
- SageGlass tintable glazing from Sage Electrochromics
- Water-efficient showerhead with H2Okinetic technology from Delta
- WeatherTRAK smart irrigation controls from HydroPoint Data Systems, Inc.
- Coolerado Cooler advanced, indirect evaporative air conditioner from Coolerado, LLC
- Renewable Energy Credits from Community Energy, Inc.

BuildingGreen Online provides online access to the BuildingGreen Suite and the GreenSpec Directory, which contains more than 1700 green building products. To find green building information by Homebuilder Category, see this URL: http://www.buildinggreen.com/menus/builderCategories.cfm

Project teams can subscribe to *Environmental Building News* (*EBN*, a monthly newsletter) or BuildingGreen Online. *EBN* is independently published, carries no advertising, and is not sponsored by any industry or related corporation. This ensures editorial freedom and avoids any hint of bias. *EBN*'s objectivity has earned the newsletter the unusual distinction of being widely respected by both environmental activists and industry groups. https://www.buildinggreen.com/ecommerce/ebn.cfm?

Passive survivability

The concept of passive survivability evolved from discussions on how to recreate a sustainable community after Hurricane Katrina and other natural disasters. Passive survivability is defined as the ability of a building to maintain critical life-support conditions for its occupants if services such as power, heating fuel, or water are lost for an extended period. It is desir-

able for the building to incorporate design features that will maintain livable conditions. A series of interesting articles published in *EBN* can be found at this URL:
http://www.buildinggreen.com/auth/article.cfm?fileName=150501a.xml

The basic concepts included in the passive survivability checklist could apply to any project that is concerned with providing livable conditions when utilities are disrupted. Details can be found at this URL:
http://www.buildinggreen.com/auth/article.cfm?fileName=150501a.xml&checklist=1

- Create storm-resilient buildings
- Limit building height
- Create a high-performance envelope
- Minimize cooling loads
- Provide for natural ventilation
- Incorporate passive solar heating
- Provide natural daylighting
- Provide solar water heating
- Provide PV power
- Configure heating equipment to operate on PV power
- Where appropriate, consider wood heat
- Store water on site; consider using rainwater to maintain a cistern
- Install composting toilets and waterless urinals
- Provide for food production in the site plan.

8 Summary and Recommendations

Summary

The Army is participating in the USGBC *LEED® for Homes* Pilot Program that will facilitate preparation and transition from SPiRiT to *LEED® for Homes*. The Norfolk District will facilitate and coordinate the *LEED® for Homes* Pilot Program and development of guidance. *LEED® for Homes* will rate housing at the Certified, Silver, Gold, and Platinum levels in recognition of the level of environmental performance achieved in five basic categories:

- Use of energy
- Use of water
- Use of materials
- Use of land
- Enhanced indoor environmental quality.

The Pilot Study project team conducted two site visits of AFH at Fort Lee, VA and Fort Huachuca, AZ. The *LEED® for Homes* tool was applied to each AFH project. The tool was enforced to determine a rating and each LEED® credit was evaluated for its applicability to Army projects. The *LEED® for Homes* checklist was used and both the rating checklist and application guidance are available from the USGBC, *LEED® for Homes* Website. The two AFH projects were reviewed as to how well using the *LEED® for Homes* rating tool and process would work with current business practices and legal constraints. Where modifications to AFH guidance are required, the CoS for AFH, Norfolk District will be responsible for recommending and implementing changes within AFH standards.

To meet sustainability goals, the Army is transitioning from the SPiRiT evaluation tool to USGBC-LEED®-NC and *LEED® for Homes* for housing evaluation tools. The analysis of *LEED® for Homes* is focused on application of this rating tool to AFH design and construction projects within CONUS. RCI and OCONUS projects are not addressed by this study. A detailed analysis is necessary to determine how *LEED® for Homes* can apply where building standards, material, and methods differ from U.S. norms. For RCI-specific requirements for transition from SPiRiT to *LEED® for Homes* for RCI would be determined by program managers.

LEED® for Homes Certification requires involvement by a third-party "Provider" to conduct testing and evaluation. The Army project team served in this role during this Pilot Study. Possible options for U.S. Army LEED® certification:

- Contractor to hire USGBC Provider to conduct independent certification.
- USACE to hire USGBC Provider to conduct independent certification.
- USACE to become a USGBC Provider and perform certifications activities.
- Contractor to meet *LEED® for Homes* certification requirements and follow procedures similar to those established for the Army's use of LEED®-NC.

The Army will adopt *LEED® for Homes* for scoring residential housing when it is released by the USGBC. It is important that the Army continue to emphasize sustainability and incorporate sustainable design and development practices into all facilities built on installations.

Recommendations

The Army transition from SPiRiT to *LEED® for Homes* has a target of LEED® Silver certification for a representative sampling of homes within each AFH construction project. All homes within a project should meet requirements for *LEED® for Homes* certification and shall continue to meet Energy Star certification requirements. Once the *LEED® for Homes* tool is formally launched, Army Family Housing program managers will issue policy on implementation of this tool for both Army MILCON and Army Family Housing.

Army homes will follow procedures similar to those already established by the Army for LEED®-NC. Formal *LEED® for Homes* certification would not be required; however, the contractor/project delivery team will fulfill the role of the *LEED® for Homes* provider and see that the project is documented and rated according to USGBC requirements. The supporting Engineer District, as Authorized Design and Construction Agent, would be responsible for reviewing the project documentation and validating all credits, in accordance with the USGBC standard, from design through construction closeout.

Though this study does not address RCI constructed homes, the concepts are still applicable and can provide value and improve sustainability for those homes.

Next Steps

Before the Army can adopt *LEED® for Homes*, the final rating tool needs a brief evaluation when it is released by the USGBC. The final *LEED® for Homes* rating tool should be compared with the previous version (Version 1.73) that was evaluated during this study. Comparison will identify any substantial changes that have been made.

Several questions must be answered before any Army policy is issued requiring AFH (and possibly RCI) projects to transition from SPiRiT to *LEED® for Homes*.

- Which credits have been changed substantially?
- Will the changes make it easier or more difficult for project teams to apply *LEED® for Homes* to Army housing projects?
- Is extra guidance needed for Army housing teams or will they be able to understand how to apply *LEED® for Homes* to their projects with USGBC-provided information?
- Is the *LEED® for Homes* Provider network robust enough to fulfill Army project needs if we choose to have homes evaluated by an official Provider? (Are they available in the geographic locations where our projects are being constructed?)
- Have any new tools or resources been created to help Army Housing teams apply *LEED® for Homes* to their projects?
- What *LEED® for Homes* rating level is appropriate for AFH considering our budget and other requirements?
- How will project teams capture and provide project documentation showing they meet the *LEED® for Homes* rating level desired by the Army?

References

Unified Facilities Criteria (UFC) 4-711-01, Family Housing, latest edition, http://www.wbdg.org/ccb/DOD/UFC/ufc_4_711_01.pdf

U.S Green Building Council, LEED® Rating System for Homes, http://www.usgbc.org/DisplayPage.aspx?CMSPageID=147

International Code Council, http://www.iccsafe.org/; IRC – *International Residential Code™*

SPiRiT (Sustainable Project Rating Tool), https://eko.usace.army.mil/_kd/go.cfm?destination=ShowItem&Item_ID=5001

SPiRiT Spreadsheet https://eko.usace.army.mil/_kd/go.cfm?destination=ShowItem&Item_ID=6419

SPiRiT project information available on EKO™ at https://eko.usace.army.mil/fa/sdd/sdd_spirit/

Sustainable Design and Development Policy Update - SPiRiT to LEED (ACSIM memo signed by Joseph W. Whitaker, Deputy Assistant Secretary of the Army (Installations and Housing) dated 05 Jan 2006) http://www.hqda.army.mil/acsimweb/fd/virlibrary/virtualLibrary/docs/SPIRIT_to_LEED_Memo_Jan_06.pdf

Requirements for Sustainable Management of Waste in Military Construction, Renovation, and Demolition Activities (13 Jan 2006) OASCIM Policy Enclosures
http://www.hqda.army.mil/acsimweb/fd/docs/C&D_encl.pdf

This policy applies to MR 6 Waste Management. Briefly stated, this policy mandates that all new construction, renovation and demolition projects include contract performance requirements to divert as a minimum 50% of non-hazardous construction and demolition (C&D) debris from landfill disposal. 50% Construction Demolition waste disposal is mentioned specifically in the MOU, and the DAIM Memorandum, however a clause was added to provide an exception to this requirement if project economics are not cost effective of if the diversion would cause a delay in the timely completion of a mission critical project.
http://www.hqda.army.mil/acsimweb/fd/docs/C&D_encl.pdf

- **FAR Part 23 - Environment, Energy and Water Efficiency, Renewable Energy Technologies, Occupational Safety, and Drug-Free Workplace –** Provisions and Contract Clauses 52.223-10 Waste Reduction Program.
- **Memorandum of Understanding (MOU) –** Federal Leadership in High Performance and Sustainable Buildings, signed by 16 Federal Agencies and the White House Council on Environmental Quality (24 January 2006). http://www.wbdg.org/pdfs/sustainable_mou.pdf
- **LEED / MOU Mapping Guide –** Whole Building Design Guide document linking LEED-NC 2.2 credits to the MOU Guiding Principles for Federal Leadership in High Performance and Sustainable Buildings: http://www.wbdg.org/pdfs/mou_leed_guide.pdf
- **Memorandum, DAIM-ZA,** Subject: Sustainable Management of Waste in Military Construction, Renovation, and Demolition Activities (06 February 2006). http://www.hqda.army.mil/acsimweb/fd/docs/Signed_c&d_memo.pdf Enclosures: http://www.hqda.army.mil/acsimweb/fd/docs/c&d_encl.pdf
- **Memorandum, DAIM-ZA**, Subject: Sustainable Management of Waste in Military Construction, Renovation, and Demolition Activities – Supplemental Guidance (11 July 2006) http://www.hqda.army.mil/acsimweb/fd/policy/docs/Signed%20revised%20memo_110706.pdf
  Enclosures (Revised 5 July 2006): http://www.hqda.army.mil/acsimweb/fd/policy/docs/Encl_Revised%20ACSIM%20C&D%20memo_110706.pdf

Appendix A: Unit Size Chart from AFH Army UFC

The following section is an excerpt from Army Family Housing (AFH) Unified Facilities Criteria (UFC) 4-711-01A edited to indicate the anticipated *LEED® for Homes* "Threshold Adjuster" for standard AFH unit sizes.

Note: This chart was created using *LEED® for Homes* version 1.73. The *LEED® for Homes* "Threshold Adjustor" table is being revised, so Table 4-1 will become out of date when the final version of *LEED® for Homes* is released by the USGBC. Planned release date for *LEED® for Homes* is November 2007.

4-1.1 Family Housing Size Standards.

Table 4-1 provides family housing standards for unit size by rank and number of bedrooms. Title 10 of United States Code, Section 2826 (10 USC 2826) directs the Services to design and construct military family housing to local standards.

Table 4-1. Unit floor area.

Rank and Number of Bedrooms	Programming Benchmark [3]			Construction Minimum		Construction Maximum	
	(GSF) [1,2]	TH [5]	GSM (m^2)	(GSF) [2]	TH [5]	(GSF) [2]	TH [5]
07 - 4BR	3330	-7	309	2600	-2	4060	-10
06 - 4BR	2520	-1	234	2110	2	2920	-4
04-05 - 4BR	2310	0	215	1920	4	2700	-3
04-05 - 3BR	2020	-3	188	1740	2	2300	-4
E9 & W4/5 - 4BR	2310	0	215	1920	4	2700	-3
E9 & W4/5 - 3BR	2020	-1	188	1740	2	2300	-4
E7/8-W1/3-03 - 5BR	2510	1	233	1920	5	3090	-4
E7/8-W1/3-03 - 4BR	2150	2	200	1800	5	2500	-1
E7/8-W1/3-03 - 3BR	1860	0	173	1670	3	2050	-1
E7/8-W1/3-03 - Mod-2BR [4]	1670	-2	155	1420	0	1920	-6
E7/8-W1/3-03 - 2BR	1490	-1	138	1180	3	1790	-5
E1-E6 - 5BR	2300	2	214	1920	2	2670	-1
E1-E6 - 4BR	1950	3	181	1670	7	2220	1
E1-E6 - 3BR	1630	3	151	1490	5	1760	1
E1-E6 - Mod-2BR [4]	1480	-1	137	1330	1	1630	-3
E1-E6 - 2BR	1340	1	125	1180	3	1500	-1

1. 10 USC 2826 requires construction project documentation (DD-1391) to specify net square footage being constructed. See Appendix B, Unit Net Area Calculations, for a graphic example of net and gross area calculations.

2. Add up to 27.9 m^2 (300 ft^2) for harsh climates. Harsh climates are defined as having more than 7,500 Heating Degree-Days (HDD), annually, or 5,500 Cooling Degree-Days (CDD), annually.

3. Gross floor area may be increased by 10% for housing units for an officer holding a special command position, for the commanding officer of a military installation, and for the senior non-commissioned officer of a military installation.

4. Mod-2BR – Modified Two Bedroom unit adds a room with closet and 3/4 bath to two-bedroom unit. The additional room is designed to serve as a den/bedroom. Mod-2BR should be limited to one-story housing unit only.

5. *LEED®-Homes* Threshold Adjuster – AFH Unit scoring 'adjustment' according to the *LEED® for Homes* Pilot Rating System, 21 September 2006 Draft. The adjuster compensates for the overarching effect of home size on resource consumption by adjusting the award level point thresholds (for certified, silver, gold, and platinum) based on home size. A "bedroom", for purposes of this adjuster, is any space that reasonably can be used as a bedroom, e.g., a space 70 square feet or greater, with egress window and closet, used or potentially to be used for sleeping. A "den," "library," "home office" with a closet, and egress window or other similar rooms shall count. (It is advantageous to count as many rooms as bedrooms as can reasonably be used for sleeping quarters.)

Appendix B: Installation Evaluation Worksheets

The following pages are the scoring sheets from the site visits to Fort Lee and Fort Huachuca. The color code corresponds to the previous discussion on specific credit analysis in Chapter 4.

Fort Lee LEED-H checklist

LEED for Homes Project Checklist					
Project: Ft Lee				Required by existing criteria	
				Not explicitly required by easily achievable	
				Not currently met, or not measured and/or contrary to criteria requirements	
			Rating	Discussion / Justification	Issues
	Location and Linkages (LL)				
1	1 LEED-ND	Neighborhood			
2	Site Selec-tion	Avoid Envi-ronmentally Sensitive Sites and Farmland	2		
3.1	Infrastruc-ture	Site within 1/2 Mile of Existing Water, Sewer, and Roads	1		
3.2		Select an Infill Site	1	Each individual site bordered a minimum of 75% redevelop-ment	
4.1	Community Resources	Within 1/4 mile of Basic Community Resources / Public Trans-portation	0		

LEED for Homes Project Checklist					
Project: Ft Lee				Required by existing criteria	
				Not explicitly required by easily achievable	
				Not currently met, or not measured and/or contrary to criteria requirements	
			Rating	**Discussion / Justification**	**Issues**
4.2		OR Within 1/4 Mile of Extensive Community Resources / Public Transportation	2	~~bank (bank, credit union),~~ community center (housing office, community center, youth center, child development facility, ~~auto skills center, craft shop, swimming pool), convenient store (shoppette), dry cleaner,~~ park (park, tennis court, ball field, playground), ~~post office,~~ place of worship (protestant, catholic, Jewish), ~~restaurant (food court, Burger King, combined club), other neighborhood-serving retail (cyber cafe, military clothing sale store, florist, concessionaire, furniture store, barber shop),~~ Other Office of Major employment Center (CASCOM Headquarters)	a-typical to have this many community resources close to FH
4.3		AND/OR Within 1/2 Mile of Green Spaces	1		
5.1	Compact Development	Average Housing Density >/= 7 Units / Acre	1	8.9 units/acre	based on 40' rear lot depth, 25' side to side, and sidewalk edge to structure
5.2		OR Average Housing Density >/= 10 Units / Acre	0		
5.3		OR Average Housing Density >/= 20 Units / Acre	0		
	Sustainable Sites (SS)				
1.1	Site Stewardship	Site Stewardship Minimize Disturbed Area of Site (If Site > 1/3 Acre)	Met		
1.2		Erosion Controls (During Construction)	Met		Required by construction standards
2.1	Landscaping	Basic Landscaping Design	Exempt		
2.2		Apply 3 to 4 Inches of Mulch Around Plants	1		
2.3		Limit Turf	0		

LEED for Homes Project Checklist					
Project: Ft Lee				Required by existing criteria	
				Not explicitly required by easily achievable	
				Not currently met, or not measured and/or contrary to criteria requirements	
			Rating	**Discussion / Justification**	**Issues**
2.4		Minimize Landscape Water Demand	1		
3	Shading of Hardscapes	Locate and Plant Trees to Shade Hardscapes	1	Hard surface driveways and sidewalks concrete; local concrete aggregates light color sand exceed 'average' concrete albedo of .35	
4.1	Surface Water Management	Install Permeable Material for at Least 65% of Lot (If Lot >/= 1/4 acre)	Exempt		
4.2		Use Permeable Paving Materials	0		
4.3		Design and Install Permanent Erosion Controls	2	Strategies employed, while not meeting the letter or the requirement for run-off reduction, meet the intent of the credit and should be eligible under CIR	Would require 11 trees or equivalent for the typical size unit; this will not work for this or Army family Housing; alternative means for landscaping exist foe landscaping for erosion control; redeveloped site and high density;
5	Non-Toxic Pest Control	Select Insect and Pest Control Alternatives from List	1.5		
	Water Efficiency (WE)				
1.1	Water Reuse	Rainwater Harvesting System	1	Via CIR, 100% elimination of potable water for irrigation; no permanent irrigation system installed; downspouts directed to turf areas for irrigation; implementation of drought tolerant/native turf and plant species.	Rainwater collection system implementation Opportunity for ID; refer to multiple buildings application guide.
1.2		Grey Water Re-Use System	0		No current criteria or encouragement for this system
2.1	Irrigation System	Main Shutoff Valve, Sub-Meter, and Third-Party Inspection	Met		Mandatory met if no irrigation system installed?

LEED for Homes Project Checklist					
Project: Ft Lee				Required by existing criteria	
				Not explicitly required by easily achievable	
				Not currently met, or not measured and/or contrary to criteria requirements	
			Rating	Discussion / Justification	Issues
2.2		Select High Efficiency Measures from List	1	Via CIR, 100% elimination of potable water for irrigation; no permanent irrigation system installed; downspouts directed to turf areas for irrigation; implementation of drought tolerant/native turf and plant species; guidance in homeowner manual on irrigation and turf species.	Credit for certified landscape design indicating no irrigation required.
2.3		Rain Sensing Controls	1	Via CIR, 100% elimination of potable water for irrigation; no permanent irrigation system installed; downspouts directed to turf areas for irrigation; implementation of drought tolerant/native turf and plant species; guidance in homeowner manual on irrigation and turf species.	
3.1	Indoor Water Use	High Efficiency Fixtures (Toilets, Showers, and Faucets)	1	Lavatory meets	
3.2		OR Very High Efficiency Fixtures (Toilets, Showers, and Faucets)	0		
	Indoor Environmental Quality (IEQ)				
1	ENERGY STAR with IAP	ENERGY STAR with IAP Meets ENERGY STAR w/ Indoor Air Package (IAP)	NA		
2.1	Combustion Venting	Combustion Venting Space Heating and DHW Equip w/ Closed/Power-Exhaust; & CO Monitor	Met		
2.2		Fireplaces w/ Outside Air Supply and Closed Combustion	Met		No fireplaces allowed - GOQ?
3	Humidity Control	Humidity Control Analyze Moisture Loads AND Install Central	1		

LEED for Homes Project Checklist					
Project: Ft Lee				Required by existing criteria	
				Not explicitly required by easily achievable	
				Not currently met, or not measured and/or contrary to criteria requirements	
			Rating	**Discussion / Justification**	**Issues**
		System (where Needed)			
4.1	Outdoor Air Ventilation	Outdoor Air Ventilation Meets ASHRAE Std 62.2	Met		
4.2		Dedicated Out-door Air Sys-tem (w/ Heat Recovery)	0		
4.3		Third-Party Testing of Outdoor Air Flow Rate into Home	1		
5.1	Local Ex-haust	Local Exhaust Meets ASHRAE Std 62.2 IE1	Met		
5.2		Timer / Auto-matic Controls for Bathroom Exhaust Fans	1		
5.3		Third-Party Testing of Ex-haust Air Flow Rate Out of Home	1		
6.1	Supply Air Distribution	Supply Air Distribution Meets ACCA Manual D	Met		
6.2		Third-Party Testing of Supply Air Flow into Each Room in Home	2		
7.1	Supply Air Filtering	Supply Air Filtering >/= 8 MERV Filters, w/ Adequate System Air Flow	Not Met		
7.2		>/= 10 MERV Filters, w/ Ade-quate System Air Flow	0		
7.3		OR >/= 12 MERV Filters, w/ Adequate System Air Flow	0		

LEED for Homes Project Checklist					
Project: Ft Lee				Required by existing criteria	
				Not explicitly required by easily achievable	
				Not currently met, or not measured and/or contrary to criteria requirements	
			Rating	Discussion / Justification	Issues
8.1	Contaminant Control	Contaminant Control Seal-Off Ducts During Construction	Met		
8.2		Permanent Walk-Off Mats OR Central Vacuum	0		
8.3		Third-Party Testing of Particulates and VOCs before Occupancy	0		Should be easily accomplished
9.1	Radon Protection	Radon Protection Install Radon Mitigation System if Home is Located in EPA Region 1	NA	Not in the region	
9.2		Install Ground Contaminant Mitigation System (Outside of EPA Region 1)	1		Follow UFC 3-490-04a
10.1	Vehicle Emissions Protection	Vehicle Emissions Protection No Air Handling Equipment OR Return Ducts in Garage	Met		
10.2		Tightly Seal Shared Surfaces between Garage and Home	Met		
10.3		Exhaust Fan in Garage OR No Garage in Contact with Hom	0		Criteria requires garages to be attached but exhaust fans are easy
	Materials and Resources (MR)				
1	Home Size	Home that is Smaller than National Average	2	Home size A,B,C=2; D=3; E,F=5	Standard for the calculation of floor area needed; net/gross, which spaces counted; ANSI Z765
2.1	Material Efficient Framing	No Extra Uses of Lumber for Aesthetic Pur-	Met		

LEED for Homes Project Checklist					
Project: Ft Lee				Required by existing criteria	
				Not explicitly required by easily achievable	
				Not currently met, or not measured and/or contrary to criteria requirements	
			Rating	**Discussion / Justification**	**Issues**
		poses			
2.2		Advanced Framing Techniques	1		Not in criteria
3	Local Sources	Materials Extracted / Manufactured / Produced within 500 Miles	2.5	fnd aggregate, fnd cement, floor sheathing, roof sheathing, landscaping, int wall framing (Candy checking)	Not in criteria
4.1	Durability Plan	Detailed Durability Plan; (Pre-Construction)	Not met	Information available but not required to be compiled anywhere	Not anywhere in criteria or requirements, needs further development; USGBC - is this excessive for this type of project? What is the value of this activity? What is being done on other project?
4.2		Third-Party Verification of Implementation of Durability Plan	0		
5.1	Environmentally Preferable Products	Tropical Hardwoods, if used, must be FSC	Met		Not regulated in our processes
5.2	Products Select Environmentally Preferable Products from List 4	Products Select Environmentally Preferable Products from List	0.5	Carpet and pad - could not verify other materials from submittals or SPiRiT insulation, paints, cabinets, countertops, recycled-content carpet & pad, GWB, insulation (Candy check)	What are low cost to encourage in specs (establish target credit)? i.e. Low VOC paint, cabinets
6.1	Waste Management	Max of 2.5 Lbs Per Square Foot of Construction Waste Sent to Landfill	Not met	Pretty sure we have not met - cannot verify - these records are not kept	Criteria currently don't require this level of detail (Annette to check with CERL experts); how do you keep track for multi unit project?
6.2	Pts for Each Additional 0.5 Lbs Per Square Foot Reduction 2	Pts for Each Additional 0.5 Lbs Per Square Foot Reduction	0		
	Energy and Atmosphere (EA)				

LEED for Homes Project Checklist					
Project: Ft Lee				Required by existing criteria	
				Not explicitly required by easily achievable	
				Not currently met, or not measured and/or contrary to criteria requirements	
			Rating	**Discussion / Justification**	**Issues**
1.1	ENERGY STAR Home	Meets ENERGY STAR for Homes with Third-Party Testing	Met	Project needs corrections to meet contract requirements	Spec item; contractors must provide label; we have process but not sure process is working - how do we get the certification?
1.2		Exceeds ENERGY STAR for Homes, 2 Pts Per HERS Point > HERS 86 EA2-7 16	Unknown		We don't have the calculations at this time to determine if this is met.
2.1	Insulation	Insulation Third-Party Inspection of Insulation Installation, At Least HERS Grade II	Unknown	Not sure how HERS works (Matt/Lisa follow-up)	Need to use p 96 checklist for inspection
2.2		Third-Party Inspection of Insulation Installation, At Least HERS Grade I	Unknown		
2.3		OR Above Code Insulation; At Least 5% > Local Code Per REScheck	Unknown	Follow-up	
3.1	Air Infiltration	Air Infiltration Third-Party Envelope Air Leakage Tested </= 0.35 ACH	Unknown	Not done yet - Candy to provide when done	Typo in the RFP - wrong decimal point on ACH
3.2		Third-Party Envelope Air Leakage Tested </= 0.25 ACH	0		
3.3		OR Third-Party Envelope Air Leakage Tested </= 0.15 ACH	0		
4.1	Windows	Windows Meet ENERGY STAR for Windows (See Table)	Met		By criteria
4.2		Windows Exceed ENERGY	0	Exceeds in SHG but not U-Value	

LEED for Homes Project Checklist					
Project: Ft Lee				Required by existing criteria	
				Not explicitly required by easily achievable	
				Not currently met, or not measured and/or contrary to criteria requirements	
			Rating	**Discussion / Justification**	**Issues**
		STAR for Windows by >/= 10% (See Table)			
4.3		OR Windows Exceed ENERGY STAR for Windows by >/= 20% (See Table)	0		
5.1	Duct Tightness	Duct Tightness Third-Party Duct Leakage Tested </= 5.0 CFM25 / 100 SF to Outside	Met		
5.2		Third-Party Duct Leakage Tested </= 3.0 CFM25 / 100 SF to Outside	1	Above minimum	UFC requires this level
5.3		OR Third-Party Duct Leakage Tested </= 1.0 CFM25 / 100 SF to Outside	0		
6.1	Space Heating and Cooling	Meets ENERGY STAR for HVAC w/ Manual J & refrigerant charge test	Met	13 SEER, 90% AFUE	Required by criteria
6.2		Exceeds ENERGY STAR for HVAC by >/= 10%, w/ Manual J	Unknown		We don't have the calculations at this time to determine if this is met.
6.3		OR Exceeds ENERGY STAR for HVAC by >/= 20%, w/ Manual J	Unknown		We don't have the calculations at this time to determine if this is met.
7.1	Water Heating	Improved Hot Water Distribution System	Not Met		No requirement in RFP for Energy Star - we could plug this hole.

LEED for Homes Project Checklist					
Project: Ft Lee				Required by existing criteria	
				Not explicitly required by easily achievable	
				Not currently met, or not measured and/or contrary to criteria requirements	
			Rating	Discussion / Justification	Issues
7.2		Improved Water Heating System	1	Water heaters spec'd @ .59 - however, this does not meet Energy Star requires .6 - this requires a change to meet Energy Star	
8.1	Lighting	Energy Efficient Fixtures and Controls	0		Need to tighten up criteria for this
8.2		OR ENERGY STAR Advanced Lighting Package	0		
9.1	Appliances	Select Appliances from List	1		Contractor provided dishwasher and refrigerator comply; occupant provided - no requirement; we need to tighten up the RFP requirement; How do you control what the occupant provides? User manual? Incentives?
9.2		Very Efficient Clothes Washer (MEF > 1.8, AND WF< 5.5)	0		
10	Renewable Energy	Renewable Electric Generation System (1 Point / 10% Annual Load Reduction)	0		
11	Refrigerant Management	Minimize Ozone Depletion and Global Warming Contribution	1	Have R-410 Puron	
	Homeowner Awareness				
1.1	Homeowner Education	Basic Owner's Manual and Walkthrough of LEED Home	Not met		Definition issue - who is the Homeowner? In government we have both DPW and occupant (Lisa look into requirement for occupant manuals)
1.2		Comprehensive Owner's			

LEED for Homes Project Checklist					
Project: Ft Lee				Required by existing criteria	
				Not explicitly required by easily achievable	
				Not currently met, or not measured and/or contrary to criteria requirements	
			Rating	Discussion / Justification	Issues
		Manual and Multiple Walk-through/Trainings			
	Innovation and Design Process (ID)				
1.1					Known potential - holistic design (charrette process), noise IEQ, collecting rainwater/greywater as a central system (Rich to send more info)
1.2					
1.3					
		TOTAL	35.5		

Fort Huachuca LEED-H checklist

LEED for Homes Project Checklist						
Project: Ft Huachuca			Possible		Required by existing criteria	
					Not explicitly required by easily achievable	
					Not currently met, or not measured and/or contrary to criteria requirements	
				Rating	Discussion / Justification	Issues
	Location and Linkages (LL)					
1	1 LEED-ND	Neighborhood	10			
2	Site Selection	Avoid Environmentally Sensitive Sites and Farmland	2	2		
3.1	Infrastructure	Site within 1/2 mile of Existing Water, Sewer, and Roads	1	1		
3.2		Select an Infill Site	1	1		
4.1	Community Resources	Within 1/4 mile of Basic Community Resources / Public Transportation	1		Public transportation is available from the PX which is w/in 1/4 mile of the housing area via a direct line; however, at Huachuca, there is a wall and drainage ditch in the path and walking distance is greater.	*In general, public transportation is not available on Army installations; where available, service is limited.*
4.2		OR Within 1/4 Mile of Extensive Community Resources / Public Transportation	2	2	Bank, community center (community center, youth center, (2) child development facility, bowling center, auto skills center, convenient store (post exchange, fire station, laundry, dry cleaner, flower shop, library, park (5 tot lots, 2 recreation fields, 4 basketball courts, 5 ball fields, 2 soccer fields), post office, place of worship (protestant, catholic, Jewish), restaurant (food court, dine at bowling alley, Popeye's Chicken, Pizza Hut), 3 schools, other neighborhood-	A-typical to have this many community resources close to FH-

LEED for Homes Project Checklist						
Project: Ft Huachuca			Possible		Required by existing criteria	
					Not explicitly required by easily achievable	
					Not currently met, or not measured and/or contrary to criteria requirements	
				Rating	Discussion / Justification	Issues
					serving retail (florist, concessionaire, furniture store, barber shop), Other Office of Major employment Center	
4.3		AND/OR Within 1/2 Mile of Green Spaces	1	1		Normal to have green space within the neighborhood - encouraged by design intent/criteria
5.1	Compact Development	Average Housing Density >/= 7 Units / Acre	1	0	Ft. Huachuca rear lots 50' fenced; where units are back to back, common area is still between units.	Generally, site sizes are estimated based on criteria / imaginary lot lines - 40' rear lot depth (from criteria, rear to read distance is 80') and 20' side to side per criteria set-back requirements. Front lot was determined from sidewalk edge to structure (assuming sidewalk is part of public right-of-way) - might consider lot line to be from centerline of street as with off-post residential development. Common space is excluded by definition form the calculations.
5.2		OR Average Housing Density >/= 10 Units / Acre	2	0		
5.3		OR Average Housing Density >/= 20 Units / Acre	3	0		
	Sustainable Sites (SS)					
1.1	Site Stewardship	Site Stewardship Minimize	Reqd	Met	Largest lot size is less than 1/4 acre (.22 acres)	

LEED for Homes Project Checklist						
Project: Ft Huachuca			Possible		Required by existing criteria	
					Not explicitly required by easily achievable	
					Not currently met, or not measured and/or contrary to criteria requirements	
				Rating	Discussion / Justification	Issues
		Disturbed Area of Site (If Site > 1/3 Acre)				
1.2		Erosion Controls (During Construction)	Reqd	Met	erosion controls on total project site	*Required by construction specs*
2.1	Landscaping	Basic Landscaping Design	Reqd	Met	The only turf that is planted is in the fenced area behind each family housing unit, selected to tolerate local conditions; no sprinkling is authorized; hand irrigation only two months out of the year.	*Project lots will normally be exempt for most Army housing projects*
2.2		Apply 3 to 4 Inches of Mulch Around Plants	1	1	Rock mulch for entire site w/the exception of the fenced area turf behind each unit.	
2.3		Limit Turf	3	2	The only turf that is planted is in the fenced area behind each family housing unit; 30% of area.	
2.4		Minimize Landscape Water Demand	3	3	100% plants selected from drought tolerant species.	
3	Shading of Hardscapes	Locate and Plant Trees to Shade Hardscapes	1	1	All concrete surfaces achieve at least .35 albedo (walks, drives, patios, pads).	Albedo rating for concrete should be part of the criteria.
4.1	Surface Water Management	Install Permeable Material for at Least 65% of Lot (If Lot >/= 1/4 acre)	Reqd	Exempt	Exempt; Lots smaller than 1/4 acre	Project lots will normally be exempt for most Army housing projects
4.2		Use Permeable Paving Materials	1	0		
4.3		Design and Install Permanent Erosion Controls	1	1	Rock swales	Would require 11 trees or equivalent for the typical size unit; this will not work for this or Army family Housing; alternative means for landscaping exist for landscaping for

LEED for Homes Project Checklist						
Project: Ft Huachuca			Possible		Required by existing criteria	
					Not explicitly required by easily achievable	
					Not currently met, or not measured and/or contrary to criteria requirements	
				Rating	Discussion / Justification	Issues
						erosion control; redeveloped site and high density;
5	Non-Toxic Pest Control	Select Insect and Pest Control Alternatives from List	2	0	Toxic pest control applications used.	
	Water Efficiency (WE)					
1.1	Water Reuse	Rainwater Harvesting System	1	0	No permanent irrigation system installed; 50% of downspouts could be directed to turf areas for irrigation; implementation of drought tolerant/native turf and plant species.	Rainwater collection system implementation Opportunity for ID; refer to multiple buildings application guide.
1.2		Grey Water Re-Use System	1	0		No current criteria or encouragement for this system
2.1	Irrigation System	Main Shutoff Valve, Sub-Meter, and Third-Party Inspection	Reqd	Met		Mandatory met if no irrigation system installed?
2.2		Select High Efficiency Measures from List	5	5	Via CIR, 100% elimination of potable water for irrigation; no permanent irrigation system installed; implementation of drought tolerant/native turf and plant species; guidance in homeowner manual on irrigation and turf species.	*Credit for certified landscape design indicating no irrigation required.*
2.3		Rain Sensing Controls	1	1	Via CIR, 100% elimination of potable water for irrigation; no permanent irrigation system installed; implementation of drought tolerant/native turf and plant species; guidance in homeowner manual on irrigation	

LEED for Homes Project Checklist						
Project: Ft Huachuca			Possible		Required by existing criteria	
					Not explicitly required by easily achievable	
					Not currently met, or not measured and/or contrary to criteria requirements	
				Rating	Discussion / Justification	Issues
					and turf species.	
3.1	Indoor Water Use	High Efficiency Fixtures (Toilets, Showers, and Faucets)	3	0		Recommend install high efficiency fixtures revision of UFC; define standard, low, and high efficiency fixtures.
3.2		OR Very High Efficiency Fixtures (Toilets, Showers, and Faucets)	6	0		
	Indoor Environmental Quality (IEQ)					
1	ENERGY STAR with IAP	ENERGY STAR with IAP Meets ENERGY STAR w/ Indoor Air Package (IAP)				
2.1	Combustion Venting	Combustion Venting Space Heating and DHW Equip w/ Closed/ Power-Exhaust; & CO Monitor	Reqd	Met	Mechanical room exterior to building; CO monitor on each floor (one floor)	
2.2		Fireplaces w/ Outside Air Supply and Closed Combustion	Reqd	Met	No fireplace	Generally fireplaces are not provided in Army Family Housing
3	Humidity Control	Humidity Control Analyze Moisture Loads AND Install Central System (where Needed)	1	1	Not needed for Huachuca environment	
4.1	Outdoor Air Ventilation	Outdoor Air Ventilation Meets ASHRAE Std 62.2	Reqd	Met		
4.2		Dedicated Outdoor Air System (w/ Heat Recovery)	2	0		Clarification needed for dedicated; implication is that there is 100% outdoor air.

LEED for Homes Project Checklist						
Project: Ft Huachuca			Possible		Required by existing criteria	
					Not explicitly required by easily achievable	
					Not currently met, or not measured and/or contrary to criteria requirements	
				Rating	Discussion / Justification	Issues
4.3		Third-Party Testing of Outdoor Air Flow Rate into Home	1	1	Third party testing part of RFP	
5.1	Local Exhaust	Local Exhaust Meets ASHRAE Std 62.2 IE1	Reqd	Met		
5.2		Timer / Automatic Controls for Bathroom Exhaust Fans	1	0		
5.3		Third-Party Testing of Exhaust Air Flow Rate Out of Home	1	1	Third party testing part of RFP	
6.1	Supply Air Distribution	Supply Air Distribution Meets ACCA Manual D	Reqd	Met		
6.2		Third-Party Testing of Supply Air Flow into Each Room in Home	2	2	Third party testing part of RFP	
7.1	Supply Air Filtering	Supply Air Filtering >/= 8 MERV Filters, w/ Adequate System Air Flow	Reqd	Not Met	Currently not part of RFP; easily rectified.	Though no current requirement, could be easily met by installation of better filters
7.2		>/= 10 MERV Filters, w/ Adequate System Air Flow	1	0		
7.3		OR >/= 12 MERV Filters, w/ Adequate System Air Flow	2	0		
8.1	Contaminant Control	Contaminant Control Seal-Off Ducts During Construction	Reqd	Met	Cleaning before occupancy.	
8.2		Permanent Walk-Off Mats OR Central Vacuum	1	0		

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8.3		Third-Party Testing of Particulates and VOCs before Occupancy	1	0		Should be easily accomplished
9.1	Radon Protection	Radon Protection Install Radon Mitigation System if Home is Located in EPA Region 1	Reqd	Met	Radon Zone 2	
9.2		Install Ground Contaminant Mitigation System (Outside of EPA Region 1)	1	1		*Follow UFC 3-490-04a*
10.1	Vehicle Emissions Protection	Vehicle Emissions Protection No Air Handling Equipment OR Return Ducts in Garage	Reqd	Met		
10.2		Tightly Seal Shared Surfaces between Garage and Home	Reqd	Met	Paint and vapor barrier to CO penetration; Local code requires direct venting of garage space to exterior	Evaluate CIR passive vent for CO control
10.3		Exhaust Fan in Garage OR No Garage in Contact with Home	1	1		Criteria requires garages to be attached but exhaust fans are easy to provide; Evaluate CIR passive vent for CO control
	Materials and Resources (MR)					
1	Home Size	Home that is Smaller than National Average	10	6	3 bedroom facility 4 points; 4 bedroom facility 6 points	Standard for the calculation of floor area needed; Sampling protocol will exclude handicapped facility; weighted

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						average size per bedroom type and occupancy by grade; net/gross, which spaces counted; ANSI Z765 - same as industry calculation
2.1	Material Efficient Framing	No Extra Uses of Lumber for Aesthetic Purposes	Reqd	Not met		No requirement in contract; overall waste factor table calculations required; calculation difficult for large projects.
2.2		Advanced Framing Techniques	2	1	Roof trusses 24" oc; Interior joists 24" oc, exterior not;	Not in criteria
3	Local Sources	Materials Extracted / Manufactured / Produced within 500 Miles	3	1.5	Foundation aggregate; cement; roofing tiles; exterior walls (stucco);	Not in criteria (EIFS elements all included?)
4.1	Durability Plan	Detailed Durability Plan; (Pre-Construction)	Reqd	Met?	RFP Durability requirements; specification; QA/QC process (bull nose corners, concrete roofing tiles 50 year, light tubes, VCT, aluminum sills, no interior sills/jams/window door molding, shelving, recessed washer/dryer receiver, metal flashed roof valleys, concrete downspout splashes, concrete pads at entries, no exterior wood, storm chain on exterior mechanical room door, rock mulched front yard, xericscape, range fire suppression system, vapor barrier, fluorescent lighting,	*Not anywhere in criteria or requirements, needs further development; USGBC - is this excessive for this type of project? What is the value of this activity? What is being done on other projects?*

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					pre-installed satellite bracket, textured wall/ceiling finishes, PV powered attic exhaust fan,)	
4.2		Third-Party Verification of Implementation of Durability Plan	3	1	RFP Durability requirements; specification; QA/QC process	
5.1	Environmentally Preferable Products	Tropical Hardwoods, if used, must be FSC	Reqd	Met		*Not regulated in our processes*
5.2	Products Select Environmentally Preferable Products from List 4	Products Select Environmentally Preferable Products from List	4	1	No carpet in house; low-VOC insulation;	*What are low cost to encourage in specs (establish target credit)? i.e. Low VOC paint, cabinet;* if VOC containing components are separated from interior spaces, ex. Wall insulation, via complete vapor barrier, are they acceptable?
6.1	Waste Management	Max of 2.5 Lbs Per Square Foot of Construction Waste Sent to Landfill	Reqd	Met	Efficient framing techniques and off site fabrication; better opportunities for efficiency given project size;	Criteria currently don't require this level of detail (Annette to check with CERL experts); how do you keep track for multi unit project?
6.2	Pts for Each Additional 0.5 Lbs Per Square Foot Reduction 2	Pts for Each Additional 0.5 Lbs Per Square Foot Reduction	2	0		
	Energy and Atmosphere (EA)					
1.1	ENERGY STAR Home	Meets ENERGY STAR for Homes with	Reqd	NA		*Spec item; contractors may provide label; statement of*

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		Third-Party Testing				*compliance is allowed in lieu of actual certification*
1.2		Exceeds ENERGY STAR for Homes, 2 Pts Per HERS Point > HERS 86 EA2-7 16	16	NA		*We don't have the calculations at this time to determine if this is met.*
2.1	Insulation	Insulation Third-Party Inspection of Insulation Installation, At Least HERS Grade II	Reqd	Met		Corps acts as third party inspector, currently doesn't have the expertise. Need to use p 96 checklist for inspection
2.2		Third-Party Inspection of Insulation Installation, At Least HERS Grade I	1	1	Exception, attic hatch insulation?	
2.3		OR Above Code Insulation; At Least 5% > Local Code Per REScheck	1	?	Potential for additional point.	RFP to IBC; walls exceed code.
3.1	Air Infiltration	Air Infiltration Third-Party Envelope Air Leakage Tested </= 0.35 ACH	Reqd	Met		Typo in the RFP - wrong decimal point on ACH
3.2		Third-Party Envelope Air Leakage Tested </= 0.25 ACH	1	1		
3.3		OR Third-Party Envelope Air Leakage Tested </= 0.15 ACH	2	0		
4.1	Windows	Windows Meet ENERGY STAR for Windows (See Table)	Reqd	Not Met		Army criteria requires a U-Value of .28
4.2		Windows Exceed ENERGY STAR for Windows by >/= 10% (See	1	0		

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				Rating	Discussion / Justification	Issues
		Table)				
4.3		OR Windows Exceed ENERGY STAR for Windows by >/= 20% (See Table)	2	0		
5.1	Duct Tightness	Duct Tightness Third-Party Duct Leakage Tested </= 5.0 CFM25 / 100 SF to Outside	Reqd	Met		Will correct criteria to meet mandatory requirements
5.2		Third-Party Duct Leakage Tested </= 3.0 CFM25 / 100 SF to Outside	1	1		*UFC requires this level*
5.3		OR Third-Party Duct Leakage Tested </= 1.0 CFM25 / 100 SF to Outside	2	0		
6.1	Space Heating and Cooling	Meets ENERGY STAR for HVAC w/ Manual J & refrigerant charge test	Reqd.	Met		*Required by criteria*
6.2		Exceeds ENERGY STAR for HVAC by >/= 10%, w/ Manual J	1	0		We don't have the calculations at this time to determine if this is met.
6.3		OR Exceeds ENERGY STAR for HVAC by >/= 20%, w/ Manual J	3	0		We don't have the calculations at this time to determine if this is met.
7.1	Water Heating	Improved Hot Water Distribution System	3	0		No requirement in RFP for Energy Star - we could plug this hole.
7.2		Improved Water Heating System	3	0		
8.1	Lighting	Energy Efficient Fixtures and Controls	1	1		Need to tighten up criteria for this

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8.2		OR ENERGY STAR Advanced Lighting Package	3	0		
9.1	Appliances	Select Appliances from List	2	1	Fridge & dishwasher	Contractor provided dishwasher and refrigerator comply; occupant provided - no requirement; we need to tighten up the RFP requirement; How do you control what the occupant provides? User manual? Incentives?
9.2		Very Efficient Clothes Washer (MEF > 1.8, AND WF< 5.5)	1	0		
10	Renewable Energy	Renewable Electric Generation System (1 Point / 10% Annual Load Reduction)	6	0		
11	Refrigerant Management	Minimize Ozone Depletion and Global Warming Contribution	1	0		
	Homeowner Awareness					
1.1	Homeowner Education	Basic Owner's Manual and Walkthrough of LEED Home	Reqd	Met	Occupant manual is required by AR 210-50; sample manual DA PAM 210-2 is dated 1971 and does not include anything on sustainability, but does discuss energy conservation	Definition issue - who is the Homeowner? In government we have both DPW and occupant
1.2		Comprehensive Owner's Manual and Multiple Walkthrough/Trainings	1	1		

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				Rating	**Discussion / Justification**	**Issues**
	Innovation and Design Process (ID)					
						Known potential - holistic design (charrette process), noise IEQ, collecting rainwater/greywater as a central system
1.1	Holistic design/charrette process			*1*		
1.2	Acoustic Environment/Noise Control			*1*		
1.3	Light tubes			*1*	illuminated address photocell controlled; light tubes in laundry, hall, kitchen, bulk storage, all baths	
1.4	PV Exhaust Fan Attic			*1*		
		TOTAL		48.5		

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Lisa Bobotas, Matt Hinson, Paul Christensen, Gary Headley, Rich Schneider, and Annette Stumpf

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803 Front Street
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U.S. Army ERDC
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14. ABSTRACT

Army participation in the *LEED® for Homes* Pilot Program is intended to facilitate preparations and transition from SPiRiT to *LEED® for Homes* as soon as it is ready for adoption. The pilot program will coincide with U.S. Green Building Council (USGBC) development of the *LEED® for Homes* evaluation tool. The Office of the Assistant Chief of Staff (Installation Management) Housing Division has overall responsibility for the transition and has selected Norfolk District, Center of Standardization for Family Housing to facilitate and coordinate participation in the *LEED® for Homes* Pilot Program.

A team consisting of Army personnel experienced in Army Family Housing (AFH) and/or sustainability conducted site visits to AFH at Fort Lee, VA and Fort Huachuca, AZ. Both installations have a history of successful AFH projects and current projects under construction that used SPiRiT as a sustainability rating tool. *LEED® for Homes* was applied to each AFH project. Further, each credit was evaluated for applicability to Army projects and its ease of application using current design guidelines. Where appropriate, feedback was provided to the USGBC regarding issues, concerns, or clarifications on particular credits. The team also defined several Innovation and Design credits that could universally apply to AFH projects.

15. SUBJECT TERMS
LEED, Army Family Housing (AFH), SPiRiT, sustainable, energy conservation, design – construction, environmental planning

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